CLAIMS

What is claimed is:

1. An apparatus for continuous and mass synthesis of carbon nanotubes, said apparatus comprising:
   (a) a discharge tube equipped with a microwave radiation generator for forming a microwave plasma torch with an ignition device and a multi-port gas injection system for injecting a carrier gas containing metal catalyst precursor vaporized and a carbon containing gas for forming carbon nanotubes;
   (b) a furnace for passing the resulting gases mixture
   (c) a collector system for quenching and collecting carbon nanotubes.
2. In the apparatus according to claim 1, wherein the said microwave plasma torch is capable of operating at 2.45 GHz and at power ranges of 0.1 to 6 kW with the assistance of auxiliary ignition systems.
3. In the apparatus according to claim 1, wherein the furnace is horizontally connected to the microwave plasma torch.
4. In the apparatus according to claim 1, wherein the furnace is 12 ~ 22 inch long.
5. In the apparatus according to claim 1, wherein said gas injection system comprising a plurality of swirl gas inlets.
6. In the apparatus according to claim 1, wherein the furnace is capable of operating at temperature in the range of 600 ~ 1200 °C.
7. A process for continuous and mass synthesis of carbon nanotubes by introduction of microwave energy into an electric field to which carbon nanotube forming material is exposed, comprising:
   (a) injecting a swirl gas as plasma or diluent gas into a dielectric discharge tube;

(b) creating an intense electric field in the swirl gas in the dielectric discharge tube by an incident and reflected electromagnetic wave generated by a magnetron and propagated through a tapered rectangular waveguide;

(c) forming an atmospheric-pressure plasma torch flame with the help of an ignition system in said electric field;

(d) introducing a vaporized metal catalyst or metal catalyst precursor and a carbon-containing gas into the center of the plasma torch flame;

(e) atomizing and ionizing carbon nanotube forming materials by molecular breakdowns and hot gases, and simultaneously mixing them with the swirl gas;

(f) passing the resulting gaseous mixtures through a furnace; and

(g) quenching and collecting carbon nanotubes in a collector system.

8. In the process according to claim 7, wherein the carbon nanotubes grow at a temperature of 600 ~ 1200 °C.

9. In the process according to claim 7, wherein the carbon nanotubes grow at one atmosphere.

10. In the process according to claim 7, wherein the transition metal catalyst is atomized at a pressure of 1 atmosphere.

11. In the process according to claim 7, wherein the carbon-containing gas is mixed and injected with the swirl gas.

12. In the process according to claim 7, wherein the metal catalyst or metal catalyst precursor is injected through one auxiliary inlet port or a plurality of inlet ports and is atomized at a temperature of 600 ~ 1200 °C.